

**WHAT IS CLAIMED IS:**

1. A method for providing a virtual private network service, comprising:
  - establishing a hose for each of a plurality of endpoints of a virtual private network;
  - coupling the hose to endpoints associated with other hoses via routing paths in a network; and
  - allocating network resources to support communications between the hose and the other hoses.

2. The method of claim 1, wherein the establishing comprises specifying a service level agreement for the hose, the service level agreement including a hose profile and other information for controlling and managing the hose.

3. The method of claim 2, wherein the establishing comprises:
  - first selecting one of a user managed hose type or a virtual private network service provider managed hose type for the hose; and
  - second selecting whether to transmit marked data packets to the hose, results of the first and second selecting steps being stored in the hose profile.

4. The method of claim 3, wherein if the user managed hose type is selected, the method further comprising:
  - specifying one or more aggregate bandwidths for the hose; and
  - specifying a time schedule for each of the aggregate bandwidths, the aggregate bandwidths and the time schedule being stored in the hose profile.

5. The method of claim 4, wherein if data packet marking is selected, the method further comprising:
  - receiving information regarding data packet markings and a quality of service corresponding to each of the data packet markings; and
  - initializing the allocated network resources to provide the quality of service based on the data packet markings if conditions in the hose profile is not violated.

6. The method of claim 3, wherein if the virtual service provider managed hose type is selected, the method further comprising:

4                   establishing one or more sub-virtual private networks, each sub-virtual  
5                   network corresponding to one of the quality of service levels;

6                   specifying one or more bandwidths for the hose corresponding to each of  
7                   the sub-virtual private networks; and

8                   specifying one or more time schedules for the bandwidths, the bandwidths  
9                   and the time schedules being stored in the hose profile.

1                 7.       The method of claim 6, wherein if data packet marking is selected, the  
2                   method further comprising:

3                   receiving information regarding data packet markings and a quality of  
4                   service corresponding to each of the data packet markings; and

5                   initializing the allocated network resources to provide the quality of  
6                   service based on the data packet markings if conditions in the hose profile is not violated.

1                 8.       The method of claim 2, further comprising:

2                   measuring communication traffic of allocated network resources to  
3                   generate monitoring data;

4                   generating a resizing condition based on the monitoring data; and

5                   resizing the allocated network resources if the resizing condition is within  
6                   one or more thresholds of the hose profile.

1                 9.       The method of claim 8, wherein the monitored data includes historical  
2                   data, the method further comprising generating trend data to predict virtual private  
3                   network usage.

1                 10.      The method of claim 8, wherein the resizing condition is one of above an  
2                   upper bound threshold, below a lower bound threshold, and within the upper bound and  
3                   lower bound thresholds.

1                 11.      The method of claim 10, further comprising:

2                   reducing the allocated network resources if the resizing condition is below  
3                   the lower bound threshold; and

4                   increasing the allocated network resources if the resizing condition is  
5                   above the upper bound threshold.

1                 12.      The method of claim 10, wherein if the resizing condition is below the  
2                   lower bound threshold by a predetermined amount, the method further comprising

3 renegotiating the hose profile to change the service level agreement to be more consistent  
4 with the monitored data.

1       13.     The method of claim 10, wherein if the resizing condition is above limits  
2 set by the hose threshold, the method further comprising renegotiating the hose profile to  
3 change the service level agreement to be more consistent with the monitored data.

1       14.     The method of claim 8, wherein the resizing condition determined based  
2 on a prediction of future virtual private network usage.

1       15.     The method of claim 1, wherein the routing paths is determined based on  
2 one or more of:

3                 network connectivity;  
4                 a hose identification; and  
5                 virtual private network identification.

1       16.     The method of claim 15, further comprising selecting the routing paths  
2 based on a shortest distance between pairs of endpoints of the virtual private network to  
3 form a pe between the pairs of the endpoints.

1       17.     The method of claim 15, further comprising:

2                 selecting the routing paths based on a source tree or a sink tree for each of  
3 the endpoints; and  
4                 minimizing a bandwidth allocation between nodes of the network by  
5 maximizing sharing of same paths for branches of the source or the sink tree extending  
6 between different ones of the endpoints.

1       18.     The method of claim 15, further comprising:

2                 selecting the routing paths based on source trees or sink trees  
3 corresponding to all endpoints of the virtual private network; and  
4                 minimizing a bandwidth allocation between nodes of the network by  
5 maximizing sharing of same paths for branches of the source or the sink trees extending  
6 between different ones of the endpoints.

1       19.     The method of claim 15, further comprising:

2                 selecting the routing paths based on source trees or sink trees  
3 corresponding to all endpoints of one or more virtual private networks; and

minimizing a bandwidth allocation between nodes of the network by maximizing sharing of same paths for branches of the source or the sink trees extending between different ones of the endpoints for all the virtual private networks.

20. The method of claim 1, wherein the network is an Internet Protocol Network.

21. A virtual private network in an network, comprising:

- a plurality of endpoints, each of the endpoints having a hose; and
- a plurality of routing paths in the network, the routing paths coupling the hose to endpoints associated with other hoses; and
- a virtual private network service provider; the virtual private network service provider allocating network resources to support communications between the hose and the other hoses.

22. The virtual private network of claim 21, wherein the virtual private network service provider receives a service level agreement for the hose, the service level agreement including a hose profile and other information for controlling and managing the hose.

23. The virtual private network of claim 22, wherein the virtual private network service provider receives a first selection of one of a user managed hose type or a virtual private network service provider managed hose type for the hose and a second selection of whether to transmit marked data packets to the hose, results of the first and second selections being stored in the hose profile.

24. The virtual private network of claim 23, wherein if the user managed hose type is selected, the virtual private network service provider receives a specification for one or more aggregate bandwidths for the hose, and a specification for a time schedule for each of the aggregate bandwidths, the aggregate bandwidths and the time schedule being stored in the hose profile.

25. The virtual private network of claim 24, wherein if data packet marking is selected, the virtual private network service provider receives information regarding data packet markings and a quality of service corresponding to each of the data packet markings and initializes the allocated network resources to provide the quality of service based on the data packet markings if conditions in the hose profile is not violated.

1           26. The virtual private network of claim 23, wherein if the virtual service  
2 provider managed hose type is selected, the virtual private network service provider  
3 receives one or more quality of service levels for the hose, establishes one or more sub-  
4 virtual private networks, each sub-virtual network corresponding to one of the quality of  
5 service levels, receives a specification of one or more bandwidths for the hose  
6 corresponding to each of the sub-virtual private networks, and receives a specification of  
7 one or more time schedules for the bandwidths, the bandwidths and the time schedules  
8 being stored in the hose profile.

1           27. The virtual private network of claim 26, wherein if data packet marking is  
2 selected, the virtual private network service provider receives information regarding data  
3 packet markings and a quality of service corresponding to each of the data packet  
4 markings, and initializes the allocated network resources to provide the quality of service  
5 based on the data packet markings if conditions in the hose profile is not violated.

1           28. The virtual private network of claim 22, wherein the virtual private  
2 network service provider measures communication traffic of allocated network resources  
3 to generate monitoring data, generates a resizing condition based on the monitoring data,  
4 and resizes the allocated network resources if the resizing condition is within thresholds  
5 of the hose profile.

1           29. The virtual private network of claim 28, wherein the monitored data  
2 includes historical data, the method further comprising generating trend data to predict  
3 virtual private network usage.

1           30. The virtual private network of claim 28, wherein the resizing condition is  
2 one of above an upper bound threshold, below a lower bound threshold, and within the  
3 upper bound and lower bound thresholds.

1           31. The virtual private network of claim 30, wherein the virtual private  
2 network service provider reduces the allocated network resources if the resizing condition  
3 is below the lower bound threshold, and increases the allocated network resources if the  
4 resizing condition is above the upper bound threshold.

1           32. The virtual private network of claim 30, wherein if the resizing condition  
2 is below the lower bound threshold by a predetermined amount, the method further

3 comprising renegotiating the hose profile to change the service level agreement to be  
4 more consistent with the monitored data.

1       33. The virtual private network of claim 30, wherein if the resizing condition  
2 is above limits set by the hose threshold, the method further comprising renegotiating the  
3 hose profile to change the service level agreement to be more consistent with the  
4 monitored data.

1       34. The virtual private network of claim 28, wherein the resizing condition  
2 determined based on a prediction of future virtual private network usage.

1       35. The virtual private network of claim 21, wherein the routing paths is  
2 determined based on one or more of:

3              network connectivity;  
4              a hose identification; and  
5              virtual private network identification.

1       36. The virtual private network of claim 34, wherein the virtual private  
2 network service provider selects the routing paths based on a shortest distance between  
3 pairs of endpoints of the virtual private network to form a pipe between the pairs of the  
4 endpoints.

1       37. The virtual private network of claim 34, wherein the virtual private  
2 network service provider selects the routing paths based on a source tree or a sink tree for  
3 each of the endpoints, and minimizes a bandwidth allocation between nodes of the  
4 network by maximizing sharing of same paths for branches of the source or the sink tree  
5 extending between different ones of the endpoints.

1       38. The virtual private network of claim 34, wherein the virtual private  
2 network service provider selects the routing paths based on source trees or sink trees  
3 corresponding to all endpoints of the virtual private network, and minimizes a bandwidth  
4 allocation between nodes of the network by maximizing sharing of same paths for  
5 branches of the source or the sink trees extending between different ones of the endpoints.

1       39. The virtual private network of claim 34, wherein the virtual private  
2 network service provider selects the routing paths based on source trees or sink trees  
3 corresponding to all endpoints of one or more virtual private networks, and minimizes a  
4 bandwidth allocation between nodes of the network by maximizing sharing of same paths

5 for branches of the source or the sink trees extending between different ones of the  
6 endpoints for all the virtual private networks.